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2006 Integrated Monitoring Plan Summary Document Rocky Flats, Colorado, Site

July 2006

U.S. Department of Energy

Office of Legacy Management

Work Performed Under DOE Contract No. DE–AC01–02GJ79491
for the U.S. Department of Energy Office of Legacy Management.

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Contents

Figures

Tables

Acronyms and Abbreviations

AOC	area of concern
AoI	analyte of interest
BDCWA	Big Dry Creek Watershed Association
BMP	best management practice
CAD/ROD	Corrective Action Decision/Record of Decision
CDPHE	Colorado Department of Public Health and Environment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
DOE	U.S. Department of Energy
DRCOG	Denver Regional Council of Governments
DQO	data quality objective
EPA	U.S. Environmental Protection Agency
FY	fiscal year
IM/IRA	interim measures/interim remedial actions
IMP	*Integrated Monitoring Plan*
Kaiser-Hill	Kaiser-Hill Company LLC
LM	DOE Legacy Management
MOU	memorandum of understanding
MSPTS	Mound Site Plume Treatment System
NREL	National Renewable Energy Laboratory
POC	point of compliance
POE	point of evaluation
POM	point of measurement
QA/QC	quality assurance/quality control
RAAMP	Radioactive Ambient Air Monitoring Program
Rad-NESHAP	"National Emission Standards for Emissions of Radionuclides other Than Radon from Department of Energy Facilities" (40 CFR 61, Subpart H)
RCRA	Resource Conservation and Recovery Act
RFCA	*Rocky Flats Cleanup Agreement*
RFS	Rocky Flats Site
RFPO	Rocky Flats Project Office
RMRS	Rocky Mountain Remediation Services
SSC	species of special concern
Site	Rocky Flats Environmental Technology Site
SWPRG	Surface Water Preliminary Remediation Goals
T&E	threatened and endangered (Species)
TSS	Total suspended solids
USFWS	U.S. Fish and Wildlife Service
VOC	volatile organic compound
WARP	Well Abandonment and Replacement Program
WRW	Wildlife Refuge Worker

End of current text

1.0 Introduction

Environmental monitoring programs at the Rocky Flats Site (RFS or Site) have evolved in response to new regulatory requirements and accelerated Site closure activities. Monitoring programs have amassed data on soils, surface water, ground water, air, and various ecological systems. The *Rocky Flats Cleanup Agreement* (RFCA) (U.S. Department of Energy [DOE], Colorado Department of Public Health and Environment [CDPHE], and U.S. Environmental Protection Agency [EPA] 1996) requires DOE, in consultation with CDPHE and EPA, to establish an integrated monitoring program that effectively collects and reports the data required to ensure the protection of human health and the environment. The program is consistent with the RFCA Preamble, and it complies with RFCA, laws and regulations, and effective management of RFS resources.

This 2006 Integrated Monitoring Plan Summary Document (IMP) identifies routine monitoring programs for surface water, ground water, air, and ecology, and associated data management systems that are designed to minimize duplication of effort among DOE, CDPHE, EPA, and the cities of Broomfield and Westminster.

The IMP details RFS monitoring activities performed for legal, contractual, and operational purposes. It restates the agreed upon types of monitoring, monitoring locations, sampling frequencies, and purposes of the monitoring. Much of the monitoring discussed in this document is performed to satisfy specific regulatory requirements that are not due to the RFCA agreement. Where this is the case, such monitoring requirements are not subject to enforcement pursuant to RFCA, but may be subject to enforcement in accordance with the initiating legal requirements. In addition, RFS monitoring programs encompass best management practices (BMPs) that are not required by RFCA or other federal and state laws and regulations. The BMPs are incorporated into the IMP, but may be dependent on the availability of federal funding in accordance with RFCA, Paragraph 249.

In developing the IMP, RFS personnel met with a working group of representatives from EPA; the State of Colorado; and the cities of Westminster, Northglenn, Thornton, Arvada, and Broomfield to develop consensus on the types of data to be gathered and their eventual uses as portrayed in the data quality objectives (DQOs) described in this IMP. The program is designed to provide data that meet the DQOs needed to support operational and regulatory decision making, and to address the requirements of the following statutes, regulations, permits, and agreements:

- Resource Conservation and Recovery Act (RCRA);
- Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA);
- Clean Air Act;
- Clean Water Act;
- Colorado Hazardous Waste Act;
- Standards promulgated by the Colorado Water Quality Control Commission;
- RFCA;
- Regulations governing natural resource (ecological) management;

- Site-specific monitoring and cleanup agreements; and
- DOE Orders and technical guidance.

1.1 Integrated Monitoring Plan

This document, which is a revision of the September 2005 Fiscal Year (FY) 2005 IMP, Rev. 1 (Kaiser-Hill Company, LLC [Kaiser-Hill] 2005a), along with the 2006 IMP Background Document (DOE 2006c), describes the activities being conducted at RFS under the IMP to satisfy RFCA and other regulatory requirements and interests. The 2006 IMP Background Document provides detailed discussions of the decision-making process that has resulted in numerous monitoring efforts at RFS. This 2006 IMP lists the monitoring programs to which DOE and the other regulatory agencies are committed. The 2006 IMP Background Document provides additional information about the DQO decision process and the regulatory framework that drives many of the monitoring decisions at RFS. The 2006 IMP Background Document is not subject to enforcement under RFCA.

This 2006 IMP lists the ongoing environmental monitoring activities that DOE, CDPHE, EPA, and other stakeholders have supported during the numerous working group meetings used to formulate monitoring-based decisions. It provides an overview of the requirements for these activities and the intended uses of the data that result. Monitoring is performed in four primary areas—surface water, ground water, air, and ecological systems. Specific RFS activities may involve soil monitoring, although Site-wide soil monitoring was discontinued in 1994 after many years of characterizing transuranic-contaminant distributions across RFS. Recently, soil monitoring has been performed on a project-specific basis, or as needed to fill gaps in our understanding for the Site Remedial Investigation/Feasibility Study. Soil data relate to other media in various ways and continue to be important to the other programs, to future projects and project planning, and to Site physical completion. Interactions among these media have been recognized and discussed in some detail in the 2006 IMP Background Document. The data collected can be used to support investigations into these interactions to the extent that the interactive effects are themselves measurable.

Each of the four major monitoring programs is discussed in this summary document. A discussion of RFS soil monitoring is included in Section 6.0, and interactions between media are included in Section 7.0 of the 2006 IMP Background Document.

1.2 Data Quality Objectives

Representatives of DOE, Rocky Flats Project Office (RFPO); Kaiser-Hill; and the various federal, State of Colorado, and local stakeholder groups together developed a set of DQOs to ensure that environmental monitoring data would satisfy the requirements of the regulations listed above and would aid in detection of conditions that could lead to unacceptable risks to public health and the environment. The data are used to: 1) measure or model contaminant movement and to identify contaminant concentrations that exceed pre-established limits; 2) address regulatory reporting requirements and commitments; 3) monitor various ecological systems at RFS; and 4) support planning, implementation, and assessment of Site actions.

Therefore, the data need to meet or exceed quality requirements to ensure accuracy in modeling, risk assessment, performance assessment, and compliance. The data must be of sufficient quality

to withstand scientific and legal scrutiny, and must be gathered using appropriate procedures for their intended use in making decisions for RFS management. Each environmental monitoring program includes a set of data usability requirements and procedures to ensure that high-quality data are produced.

1.3 Quality Assurance

The quality of the RFS environmental monitoring data is ensured through careful planning and design of monitoring programs and implementation of work control procedures that address sampling, analysis, and data management activities. Presented in this document are statements of the major decisions that need to be made based on monitoring data, how the data will be applied in decision making, and the approaches used to obtain the data. Procedures cover monitoring activities, including sampling, analysis, and data management, and consist of approved, controlled documentation.

RFS environmental program and analytical services managers have a significant role in controlling the quality of environmental monitoring data. They are responsible for designing adequate environmental monitoring programs, collecting environmental samples and field data of high quality, properly submitting samples, ensuring data are managed per procedures, and interpreting and reporting monitoring results.

Minimum requirements for laboratory quality assurance/quality control (QA/QC) programs have been promulgated. These requirements ensure that each laboratory generating data has procedures for assuring that the precision, accuracy, completeness, and representativeness of data generated are known and documented.

Additionally, analytical data are subject to data assessment (QA evaluation of analytical chemistry data). Assessments cover monitoring activities, including sampling and analysis. Subcontracted laboratories are routinely audited and participate in inter-laboratory cross-check programs. The 2006 IMP Background Document details the overall QA/QC requirements including field duplicate and blank samples, analytical detection limits, and standards for accuracy and completeness.

1.4 Future of the Integrated Monitoring Plan

Following completion of the cleanup and closure of the Site, DOE's Office of Environmental Management, which is responsible for the cleanup, transferred management of the lands that DOE retains to DOE's Office of Legacy Management (LM). LM was established in December 2003 to conduct long-term management activities for DOE sites that no longer support DOE's ongoing missions, including disposal sites and other remediated sites such as RFS. At RFS, LM will also be responsible for compliance with long-term requirements outlined in the Site's Corrective Action Decision/Record of Decision (CAD/ROD) and implemented through the post-closure RFCA.

Under this IMP, work is now performed for DOE-LM through subcontractors performing under contract.

End of current text

2.0 Surface Water Monitoring

2.1 Introduction

The surface-water monitoring program at RFS addresses the requirements of statutes, regulations, orders, and agreements, and supports many decision-making processes. Surface-water monitoring (summarized in Table 2−1) encompasses five areas:

- Site-wide water quality;
- Quality of waters within the former Industrial Area;
- Quality of discharges from the former Industrial Area;
- Quality of water leaving RFS; and
- Off-Site water quality.

Protocols for sampling and analysis of surface water, as well as QA/QC requirements, are defined in several documents. Refer to Section 2.1.5 of the 2006 IMP Background Document, (DOE 2006c), for details.

RFS maintains surface-water data in the SEEPro database (formerly the Rocky Flats Soil and Water Database). The data can be retrieved and reported in many formats for specific purposes. Many of the data generated are not specifically reported in RFS documentation, but are provided to requestors or decision makers as needed. However, regularly generated reports include:

- Pre-discharge and community assurance monitoring results gathered by the State, and reported routinely to RFS and nearby cities;
- Reportable RFCA monitoring results (those above RFCA standards and action levels) reported to EPA and CDPHE;
- Quarterly Reports of Site Surveillance and Maintenance Activities which contain a summary of surface-water monitoring data collected in the respective period at RFS; and
- Annual Reports of Site Surveillance and Maintenance Activities which will contain a complete evaluation of surface-water monitoring data collected during the calendar year.

2.2 Site-Wide Water Quality

This section deals with surface-water monitoring objectives that are not confined to a particular part of RFS. Site-wide monitoring includes:

- Monitoring the dams that form the RFS detention ponds (dams lie within a defined area, but monitoring is performed to ensure their integrity and safety);
- Specific monitoring activities in response to requests (i.e., ad hoc monitoring);
- Monitoring of indicator parameters to evaluate concentrations and levels of laboratory analyzed constituents; and
- Investigative monitoring to provide upstream water-quality information in the event of reportable observations at RFCA Points of Evaluation (POEs) or Points of Compliance (POCs).

Table 2–1. Surface-Water Monitoring Matrix

Type of Monitoring	Locations	Target Sampling Frequency	Sampling Performed By	Purpose
Site Wide				
Dam Operations—Imminent Danger to Life and Health	Retention ponds	Various regular intervals	Site personnel	Assess need for discharges from ponds to ensure dam integrity
Streamflow	Seven stream locations	Continuous when flowing	Site personnel	Determine streamflow upgradient of Ponds A-3, A-4, B-5, and C-2. Determine outflow from Ponds A-3, A-4, B-5, and C-2
Pond Elevations	Five pond locations	Daily (hourly if needed)	Site personnel	Monitor amount of water detained in Ponds A-3, A-4, B-5, East Landfill Pond, and C-2
Piezometers	Dams at Ponds A-3, A-4, B-1, B-3, B-5, C-2, and East Landfill Pond	Continuous	Site personnel	Monitor level of saturated zone in detention structures
Dam Integrity Inspections	Twelve dams	Various	Site, DOE, and Federal Energy Regulatory Commission personnel	Assess physical integrity of earthen dams
Ad Hoc	One location	As needed[a]	Site personnel	Address need for special monitoring
Indicator Parameter	Varies	As needed[a]	Site personnel	Evaluation of analytical results using indicator parameters
Former Industrial Area				
Investigative Monitoring	Five locations	Varies[a] (total approximately 40 samples)	Site personnel	Establish baseline conditions and monitor effects of RFS actions on water quality
Performance Monitoring	Eleven locations	Varies[a] (total approximately 62 samples)	Site personnel	Establish baseline conditions and monitor effects of RFS actions on water quality
Former Industrial Area Discharges To Ponds				
Point of Evaluation	Three Action Levels and Standards Framework locations	Varies[a] (total approximately 49 samples)	Site personnel	Monitor compliance with RFCA action levels

Table 2−1 (continued). Surface-Water Monitoring Matrix

Type of Monitoring	Locations	Target Sampling Frequency	Sampling Performed By	Purpose
Water Leaving the Site				
Predischarge	Ponds A-4, B-5, and C-2	About 6–8 events per year (1 event per year at C-2)	Site personnel (CDPHE analyzes samples)	Determine expected quality of water and safety of discharges from terminal ponds
Point of Compliance	Five locations	About 5 samples for each of 6–8 discharge events, plus 3–7 samples per month between discharges[a]	Site personnel	POC monitoring
Non-POC at Indiana Street				
CDPHE Monitoring	Walnut Creek and Woman Creek Drainages	Total of 4 samples annually	CDPHE	Assess effects of flow changes on water leaving RFS
RFS Monitoring	Walnut Creek Drainage	Total of 64 samples annually	Site personnel	Assess nitrate water-quality for water leaving RFS
Off Site				
Uncharacterized Discharges	Five primary locations, but could vary with circumstances of discharge	As needed[a]	Site personnel	Assess impact of uncharacterized discharges on community water supply facilities
Community Assurance	Four points in Westminster and Broomfield water treatment process streams	Weekly, with samples composited semiannually or annually	Westminster and Broomfield municipal employees	Notify municipalities in the event of water-quality exceedances; provide data for dose reconstruction studies

[a] Sampling frequency is determined based on decision documents. (Refer to FY 2005 IMP Background Document, Rev. 1, for more information.)

Notes:
CDPHE = Colorado Department of Public Health and Environment
POC = Point of compliance
RFCA = Rocky Flats Cleanup Agreement
RFS = Rocky Flats Site

The site-wide monitoring is described below.

2.2.1 Monitoring Dam Operations

The RFS retention ponds (Figure 2−1) are formed by earthen dams, which are designed for storm water retention. Once water quality is determined to meet downstream standards, water is routinely discharged in a controlled manner from the final or terminal ponds to maintain safe pool levels. Although water rarely rises to the elevation of emergency spillways, there is a risk that the dams could fail or sustain damage under extreme conditions.

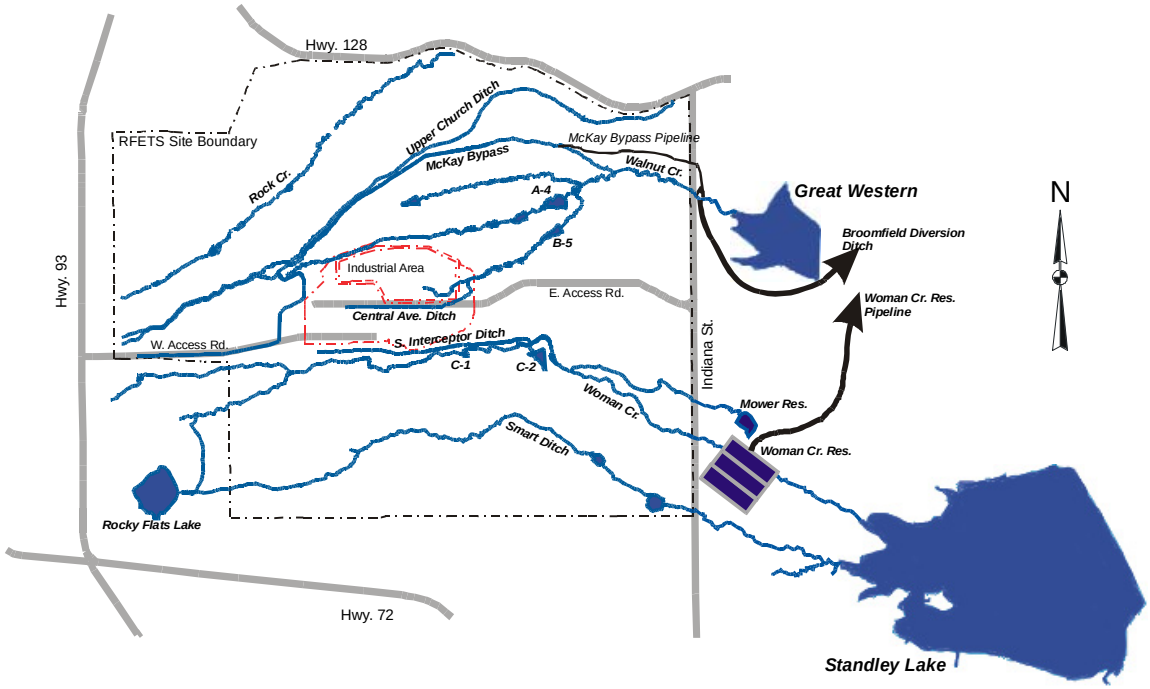

Figure 2–1. Schematic Surface-Water Map

RFS uses data from the monitoring activities listed below, along with water-quality data from the ponds, within a specific decision-making process (see 2006 IMP Background Document, Section 2.2.1, and ancillary documents cited therein) to determine if, and when, water should be discharged from the ponds. RFS performs the following monitoring activities:

- Measure streamflow upgradient of Ponds A-3, A-4, B-5, and C-2.
- Measure outflow from Ponds A-3, A-4, B-5, and C-2.
- Monitor pond water elevations at regular intervals in Pond A-3, East Landfill Pond, and terminal ponds A-4, B-5, and C-2. Weekly to monthly monitoring is adequate for normal operations; daily or even hourly monitoring is invoked as established by procedure (e.g., in response to storms) to ensure dam safety.
- Monitor piezometers installed in the dams to track the level of the saturated zone within the earthen detention structures.

- Evaluate dam integrity through visual inspections at appropriate frequencies as determined by best engineering judgment or procedure.
- Perform routine integrity inspections on dams on the 12 ponds at appropriate frequencies, as determined by best engineering judgment, and perform a detailed internal inspection annually. Federal Energy Regulatory Commission and DOE personnel conduct an annual external inspection of the dams.
- Monitor the inclinometers and dam crest movement monuments twice a year to identify any movement of dam structure.
- Annually exercise the valves in the outlet works of the terminal dams to ensure operability, as directed by the Colorado State Engineer.

Data are entered into a spreadsheet model to assess the need for discharge, based on the *Rocky Flats Environmental Technology Site Surface Water Pond Operations Plan* (DOE 2005a) and applicable procedures. Meteorological data are also used in the model, along with inflow and discharge rates as applicable.

2.2.2 Ad Hoc Monitoring

Ad hoc monitoring is designed to address specific identified data needs. The data needs arise in response to circumstances that are not addressed by the routine monitoring program. Ad hoc monitoring falls into one of two categories:

- Required—Statutory, regulatory, permit, or other requirements mandate that monitoring must be done to obtain analytical data; and
- Discretionary—Where analytical data could help with further decision making, or a need for additional data is otherwise strongly indicated.

Ad hoc monitoring may be conducted in response to events such as unusual precipitation volumes, community concerns, changes in permit or regulatory requirements, construction projects, operations, or spills.

2.2.3 Indicator Parameter Monitoring for Analytical Water-Quality Assessment

RFS continues to study whether a correlation can establish relationships between analytical measurements of constituents, such as actinides or metals, and selected indicator parameters (i.e., total suspended solids [TSS], precipitation, and flow rate).

Plutonium concentrations are already being monitored at the terminal pond outfalls and at the Indiana Street RFCA POCs. RFS also monitors TSS concentrations when possible for samples collected at the locations covered by the other decision rules in this section. To evaluate the relationship between precipitation and analytical constituents, precipitation is currently monitored at eight locations across RFS.

Based on this analysis, this monitoring objective may be modified in the future to further define observed correlations. Although correlation can be demonstrated under some conditions, the results have not shown a reliable quantitative correlation across the Site sufficient to allow indicator parameters to be substituted for the primary measurements. The indicator parameters

prove useful as an investigative tool to assist in understanding source-related environmental conditions.

2.2.4 Investigative Monitoring

When reportable water-quality measurements are detected by surface-water monitoring at POEs or POCs, additional monitoring may be required to identify[1] the source and evaluate for mitigating action pursuant to RFCA through the consultative process. This Investigative Monitoring objective is intended to provide upstream water-quality information should reportable water-quality values be detected at RFCA POEs or POCs. Data collection is limited to POE and POC analytes of interest (AoIs) and is intended to be discontinued once acceptable water-quality has been demonstrated at POEs and POCs for an extended period.

2.3 Water Quality Within the Former Industrial Area

RFS monitors water within the former Industrial Area to assess the performance of accelerated actions. RFS conducts remedy-specific performance monitoring under this portion of the surface-water monitoring program as summarized in the following subsections.

2.3.1 Performance Monitoring

2.3.1.1 Present Landfill Monitoring

The objective of this section is to describe post-accelerated action surface-water monitoring requirements necessary to determine the short- and long-term effectiveness of the remedy. These requirements are identified in the *Final Interim Measures/Interim Remedial Action for IHSS 114 and RCRA Closure of the RFETS Present Landfill*, (IM/IRA) "Appendix B: Post-Accelerated Action Monitoring and Long-Term Surveillance and Monitoring Considerations," including institutional controls, inspection and maintenance, and environmental monitoring (DOE 2004b). These requirements are specific to the accelerated actions described in the Present Landfill IM/IRA.

The landfill seep and ground water intercept system flow will be sampled at three influent streams to the treatment system and at the National Pollutant Discharge Elimination System outfall (treatment system effluent). The analytes that will be sampled for are listed in Table 5−1 of the *Present Landfill Monitoring and Maintenance Plan and Post-Closure Plan* (DOE 2006b).

2.3.1.2 Original Landfill Monitoring

The objective of this section is to describe post-accelerated action surface-water monitoring requirements necessary to determine the short- and long-term effectiveness of the remedy. These requirements are identified in the Draft Final IM/IRA of IHSS Group SW-2, IHSS 115, Original Landfill and IHSS 196, Filter Backwash Pond, "Appendix B: Post-Accelerated Action Monitoring and Long-Term Surveillance and Monitoring Considerations," including institutional controls, inspection and maintenance, and environmental monitoring (DOE 2004c). These requirements are specific to the accelerated actions described in the Original Landfill IM/IRA.

[1] Note that the term "identify" is used here to mean "locate." Characterization is also implied.

Surface water in Woman Creek will be sampled both upstream (GS05) and downstream (GS59) of the Original Landfill. The analytes that will be sampled are detailed in the *Final Landfill Monitoring and Maintenance Plan, Rocky Flats Environmental Technology Site, Original Landfill* (DOE 2006a).

2.3.1.3 Passive Ground Water Treatment Systems: Mound Site, East Trenches, and Solar Ponds Plume Treatment Systems

Surface water is sampled at specified locations downgradient of several ground water treatment systems to enhance the performance valuation of these systems. Contaminated ground water is intercepted and treated in three areas of the Site. The ground water intercept trenches are similar to a French drain with an impermeable membrane on the downgradient side. Ground water entering the trench is routed through the drain pipe into a treatment cell, where it is treated and discharged to surface water.

The three systems include the Mound Site Plume Treatment System (MSPTS), East Trenches Plume Treatment System, and Solar Ponds Plume Treatment System. The MSPTS was installed in 1998, and the other two were installed in 1999. Each system features at least two sample collection points that enable the collection of, at a minimum, untreated influent entering the treatment cells and treated effluent exiting the cells. While these samples may not strictly represent ground water, the monitoring of these systems is included in the Ground Water section of the IMP. Monitoring decisions also depend on surface water quality at designated "performance monitoring" locations downgradient of the discharge area of each treatment system. Because the associated DQOs support the ground water treatment systems, these surface-water locations are addressed in detail in the Ground Water Monitoring section. The details regarding surface-water data collection are duplicated in the Surface Water Monitoring section for completeness.

2.3.1.4 IHSS 118.1 Monitoring

SW018 is also monitored in support of ground water objectives. This sampling location is in the unnamed tributary to North Walnut Creek downgradient (west-northwest) of IHSS 118.1. This IHSS was originally identified because of historic spills of carbon tetrachloride. The IHSS was remediated via source removal in 2004, but the associated plume of volatile organic compound (VOC)-contaminated ground water persists. To assess whether this plume is impacting surface water, SW018 is monitored for VOCs.

Decisions associated with these locations are similar to those for Area of Concern (AOC) wells (Section 3.3 of the 2006 IMP Background Document, Figure 3−3). See Appendix B of the 2006 IMP Background Document for summary information on monitoring requirements.

2.3.1.5 CDPHE Performance Monitoring for Mound and East Trenches Plume Treatment Systems

The Mound and East Trenches ground water contamination plumes contain VOCs. The concentrations of some metals also appear elevated in these plume areas. Ground water collection and treatment systems have been installed, and the treatment appears to be effective. However, it is possible that some contaminated ground water either was already downgradient of the collection systems before they were installed, or that some ground water may be bypassing

the collection trenches. There is no in-stream monitoring specified in the decision documents for these systems that can either verify or disprove this. To verify that stream standards are being attained, monitoring for VOCs and selected metals will be done in South Walnut Creek at POM2 and POM3.

2.3.1.6 CDPHE Performance Monitoring for Solar Pond Plume Treatment System

The Solar Ponds ground water contamination plume contains high levels of nitrates and uranium, and lower concentrations of several other metals. Ground water collection and treatment systems have been installed, and the treatment appears to be effective. However, it is possible that some contaminated ground water either was already downgradient of the collection system before it was installed, or that some ground water may be bypassing the collection trench.

While RFS monitors in-stream nitrate and uranium concentrations, CDPHE will perform in-stream monitoring for metals. These data will be used to verify that stream standards are being attained.

2.4 Former Industrial Area Discharges To Ponds

This section addresses monitoring of surface water before it arrives in the terminal ponds (i.e., surface waters running off of the former Industrial Area to waters upstream of the terminal ponds). These discharges are the major transport pathways available for contaminants leaving the Industrial Area. Merely monitoring the terminal pond discharges is not adequate to protect water quality above the terminal ponds (in compliance with RFCA requirements), or to detect changes in contaminant runoff from within the Industrial Area.

2.4.1 Point of Evaluation Monitoring

RFS monitors water quality at three RFCA POE monitoring locations (as represented by stations SW093, SW027, and GS10) for compliance with RFCA action levels. Reportable values require development of a source evaluation plan and source evaluation.

The RFCA Action Levels and Standards Framework provides criteria for identified contaminants. A subset of these contaminants is monitored under this portion of the program (see Table A−1 in Appendix A of the 2006 IMP Background Document). RFS collects samples (one to four per month depending on flows) from each station for an estimated total of 49 samples during the year (see Table 2−20 in the 2006 IMP Background Document). The number of samples collected from each station is determined using historical flow data.

Collecting only one sample per month and analyzing only for the AoIs listed above would be sufficient to comply with RFCA requirements. However, the higher number of samples reduces the chance of recording a false exceedance or of missing a short-duration event. Sampling frequency may be adjusted to accommodate changing data needs.

2.5 Water Leaving the Site

This section covers all surface water monitoring in streams leaving the eastern Site boundary (Indiana Street). This water is first monitored prior to discharge from the terminal ponds.

Monitoring for RFCA compliance takes place at the terminal pond outfalls, and in both Woman and Walnut Creeks, near Indiana Street (RFCA POCs). Additional non-POC monitoring at Indiana Street was identified by the working group and is described at the end of this section. Three monitoring objectives have been established to assess water quality:

- Predischarge monitoring;
- RFCA POC monitoring; and
- Additional, non-POC monitoring.

2.5.1 Predischarge Monitoring

Before water is discharged from the terminal ponds, it must be evaluated for a range of constituents to ensure its safety and that unexpected contaminants have not been introduced. Therefore, RFS collects predischarge samples six to eight times per year from the Walnut Creek Drainage at Ponds A-4 (North Walnut Creek) and B-5 (South Walnut Creek), once per year from the Woman Creek Drainage at Pond C-2, and as needed from any other upstream pond temporarily functioning as a terminal pond. RFS and CDPHE analyze the samples for an extensive list of constituents, including inorganic compounds, metals, and radiologic parameters (see Tables 2−21 and 2−22 in the 2006 IMP Background Document, for analyte list and sampling targets). Sampling and analyses are conducted far enough in advance of a planned discharge to allow action to be taken if exceedances are noted, but near enough to the time of discharge to be representative of the discharge composition.

2.5.2 Point of Compliance Monitoring

RFS performs monitoring at five RFCA POC stations (GS11, GS08, GS31, GS03, and GS01). POC monitoring is concerned primarily with concentrations of plutonium, americium, and total uranium. About five samples are collected during each pond discharge event (historically, about six to eight discharge events per year but fewer are expected in the future; see Table 2−23 in the 2006 IMP Background Document, for POC monitoring targets), and flow-proportional sampling is conducted between discharges when flow rates are sufficient to obtain required water sample volumes.

2.5.3 Non-POC Monitoring at Indiana Street

2.5.3.1 CDPHE Non-POC Monitoring at Indiana Street

Various off-Site reservoir construction and water diversion projects will cause changes in the surface-water flow regime. CDPHE conducts additional monitoring to assess the effects of these flow changes on nutrient loads in water leaving RFS. CDPHE collects samples semiannually from Walnut Creek to assess the composition of the water when it consists of:

- 100 percent RFS effluent;
- Mixed effluent and natural stream flow; or
- 100 percent natural stream flow.

In addition to these samples, CDPHE collects an annual sample from Woman Creek during a Pond C-2 discharge. Samples are analyzed for a variety of parameters, including water quality and selected metals.

2.5.3.2 RFS Non-POC Monitoring at Indiana Street

To assess nitrate water quality in lower Walnut Creek, RFS analyzes all terminal pond discharge samples for nitrate. The analyzed samples are the same samples collected under the POC objective during pond discharges only.

RFS performs non-POC nitrate monitoring at three RFCA POC stations (GS11, GS08, and GS03). About five samples are collected during each pond discharge event (about six to eight discharge events per year; see Table 2−23 in the 2006 IMP Background Document, for POC monitoring targets).

2.6 Off-Site Monitoring to Support Community Water Supply Management

RFS and CDPHE personnel provide monitoring data to nearby communities for their use. Procedures are in place to monitor uncharacterized discharges from RFS and to provide data that address public concerns regarding water quality.

2.6.1 Monitoring Uncharacterized Discharges

Monitoring of uncharacterized discharges would normally be required only if monitoring, specified under the previous decision rules, is not performed in accordance with the sampling and analysis protocols (e.g., POC monitoring at Indiana Street) or if flow leaving RFS exceeds the capacity of the downstream ditch or reservoirs.

If surface water of unknown quality (unmonitored) leaves RFS, it is necessary to demonstrate that the water quality is acceptable to downstream users. Examples include:

- Unmonitored storm flow exceeding the capacity of Broomfield's diversion ditch that enters Great Western Reservoir; and
- Downstream water that may have been impacted by unmonitored effluent from RFS.

2.6.2 Community Assurance Monitoring

Several factors have made it necessary for the communities to reassure residents that their environment is safe. These factors include the Site's past mission as a nuclear weapons production facility, the nature of the contaminants, the history of releases and accidents, and the geographic and hydrologic relationship of RFS to the neighboring municipalities. Adequate and timely information regarding the impact of RFS is necessary. The level of concern fluctuates with activities at RFS, but may be expected to continue as long as environmental contamination is present at RFS.

Since the completion of the Standley Lake Protection Project and the Great Western Reservoir Replacement Project, which were designed to protect potable water supplies, routine monitoring of the municipal treatment and distribution systems is no longer warranted. However, Great Western Reservoir is still used as an irrigation supply. Therefore, during FY 2006, community

assurance monitoring continues at Great Western Reservoir as specified in Section 2.6.2 of the 2006 IMP Background Document.

2.7 Watershed Integration

Geographically, RFS lies at the head of the Big Dry Creek Basin; functionally, every effort has been made to isolate RFS from the rest of the watershed. Historical strategies on the part of RFS and the downstream communities have focused on limiting, to the maximum extent possible, the natural flow of surface water from RFS. Examples include past spray irrigation practices, the "Zero Discharge" goal, and the continuing detention of stormwater pending demonstration of acceptable water quality. Although these water management practices have been necessary to protect and reassure the downstream communities, they negatively impact the ecology of the basin and are inconsistent with the ultimate vision for the Site, as outlined in RFCA. As RFS nears physical completion, the focus must evolve toward integrating the headwaters of Big Dry Creek with the rest of the watershed.

To accomplish this objective, RFS must extend its water management strategy beyond Indiana Street, and participate with other stakeholders in identifying and implementing appropriate water-quality and use goals for the basin. During 1996, DOE and its contractors progressed toward this goal by actively participating in a consensus group with the objective of achieving agreement on as many issues as possible prior to a standard-setting hearing before the Colorado Water Quality Control Commission. The group included representatives from RFS, regulatory agencies and surrounding communities, but the focus was limited to water-quality issues impacting wastewater dischargers.

More recently, RFS personnel helped to establish the Big Dry Creek Watershed Association (BDCWA). The BDCWA began as an extension of the original consensus group, but evolved to include any entities or individuals interested in water-related issues within the basin. In addition to the original four dischargers (i.e., RFS, Broomfield, Westminster, and Northglenn), participants included representatives of agriculture, land owners, parks, recreation, open space, and a variety of government agencies. The BDCWA was recognized by the Denver Regional Council of Governments (DRCOG) as a district watershed in the Regional Clean Water Plan. The goals of the BDCWA include public education, monitoring activities, and protection of water quality, aquatic life, and habitat.
DOE recognized the effectiveness of this approach by becoming a party to a formal agreement to participate, with the cities, in supporting monitoring activities within the basin. The agreement stated that such support may consist of monetary contributions or in-kind services, but shall be equitably distributed among the parties. Monitoring decisions were made jointly by the group, with input from regulators and planning agencies including EPA, the Water Quality Control Division, and DRCOG. The immediate use of the data was to characterize the watershed, and to identify and quantify sources of impairment. Ultimately, water quality and biological data were used to support water-quality standards, native species protection, and basin-wide planning activities. A coordinated effort to obtain accurate information about existing conditions and relative impacts was beneficial and cost-effective for stakeholders.

End of current text

3.0 Ground Water Monitoring

This section summarizes the Ground Water Monitoring Program at RFS. For complete details, see the 2006 IMP Background Document (DOE 2006c). The Ground Water Monitoring Program is designed to accomplish the following:

- Monitor contaminated ground water and sources of contamination;
- Monitor contaminant pathways to surface water;
- Develop resources for evaluating contaminant concentration trends using specific statistical methods;
- Monitor accelerated action activities;
- Monitor ground water flow for ground water modeling activities;
- Evaluate the effects of Site closure activities (particularly removal of buildings, underground utility infrastructure, and impervious surfaces such as pavement) on ground water characteristics; and
- Evaluate the impacts of ground water contaminants on surface water.

3.1 Ground Water Monitoring Focus

Contaminant plumes have been identified in RFS ground water (for example, see the *2003 Annual RFCA Ground Water Monitoring Report*, Kaiser-Hill 2004a). The main AoIs in ground water are VOCs, nitrate, and uranium. Possible sources of contaminants that could affect ground water include former storage tanks, process waste lines, drains, sumps, historical storage and disposal areas, and spills.

The monitoring network is designed from a holistic, Site-wide perspective; its primary objective is to evaluate potential impacts of known ground water contaminant plumes on surface water quality, by focusing on monitoring ground water within and downgradient of contaminant plumes and in surface-water drainages.

The FY 2005 IMP established new monitoring well classifications and a new system of evaluating ground water contaminant concentrations that are unchanged in this 2006 IMP. This system includes three main evaluation criteria:

- Statistically-derived 85th percentile concentrations to be compared with surface-water standards;
- Specific statistical methods to determine concentration trends; and
- RFCA Tier I and Tier II Ground Water Action Levels;
- Concentrations in downgradient wells are compared against those in upgradient wells; and
- Comparison with Wildlife Refuge Worker Surface Water Preliminary Remediation Goals (WRW SWPRGs; Kaiser-Hill 2004b).

The ground water monitoring network (Figure 3−1) is now defined with the following well classifications, the first three of which comprise the majority of the network:

- AOC Wells: Located within a drainage and downgradient of a contaminant plume or group of contaminant plumes. These wells are monitored to determine whether the plume(s) may be discharging to surface water. Two sampling locations in surface water are also monitored to support AOC well objectives.
- Sentinel Wells: Typically located near downgradient edges of contaminant plumes, in drainages, and at and downgradient of ground water treatment systems. These wells are monitored to determine whether concentrations of contaminants are increasing, which could indicate plume migration or treatment system problems.
- Evaluation Wells: Typically located within plumes and near plume source areas, or in the interior of the Industrial Area. Data from these wells will help determine when monitoring of an area or plume can cease. A subset of these wells is located in areas that may experience significant changes in ground water conditions as a result of Site closure activities.
- Boundary Wells: Located on the east boundary of the Site, where Walnut Creek and Woman Creek flow off Site. These wells are used to show that AoIs are not migrating off Site.
- RCRA Wells: Dedicated to monitoring the Present Landfill and Original Landfill to determine the influence on ground water quality resulting from these areas.
- Decision Document Wells: Wells identified in any of four decision documents and that were recommended by the Ground Water IMP Working Group for removal from the monitoring network when these documents are modified or replaced. (Additional wells support these decision documents and are also recommended for removal from the monitoring network; see Section 3.3.9 of the 2006 IMP Background Document for details.) The four decision documents are: *Major Modification to the Operable Unit 1: 881 Hillside Area Corrective Action Decision/Record of Decision* (DOE 2001); *Decision Document for the Mound Site Plume* (DOE 1997); *Proposed Action Memorandum for the East Trenches Plume* (DOE 1999a); and *Final Solar Ponds Plume Decision Document* (DOE 1999b).

The ground water monitoring network also includes two monitoring classifications that do not provide analytical data on ground water in specific locations:

- Water Level Wells: Located between areas being actively monitored, in areas subject to changing flow conditions during and following Site closure, and in areas addressed by decision documents (see above). These wells are routinely monitored for water levels only (not analytical data).
- Ground Water Treatment System Monitoring Points: Three ground water treatment systems at the Site collect and treat contaminated ground water and discharge the treated water to ground water or surface water. Each system is monitored, at a minimum, for influent and effluent water quality, and for impacts to surface water downstream of the effluent discharge point.

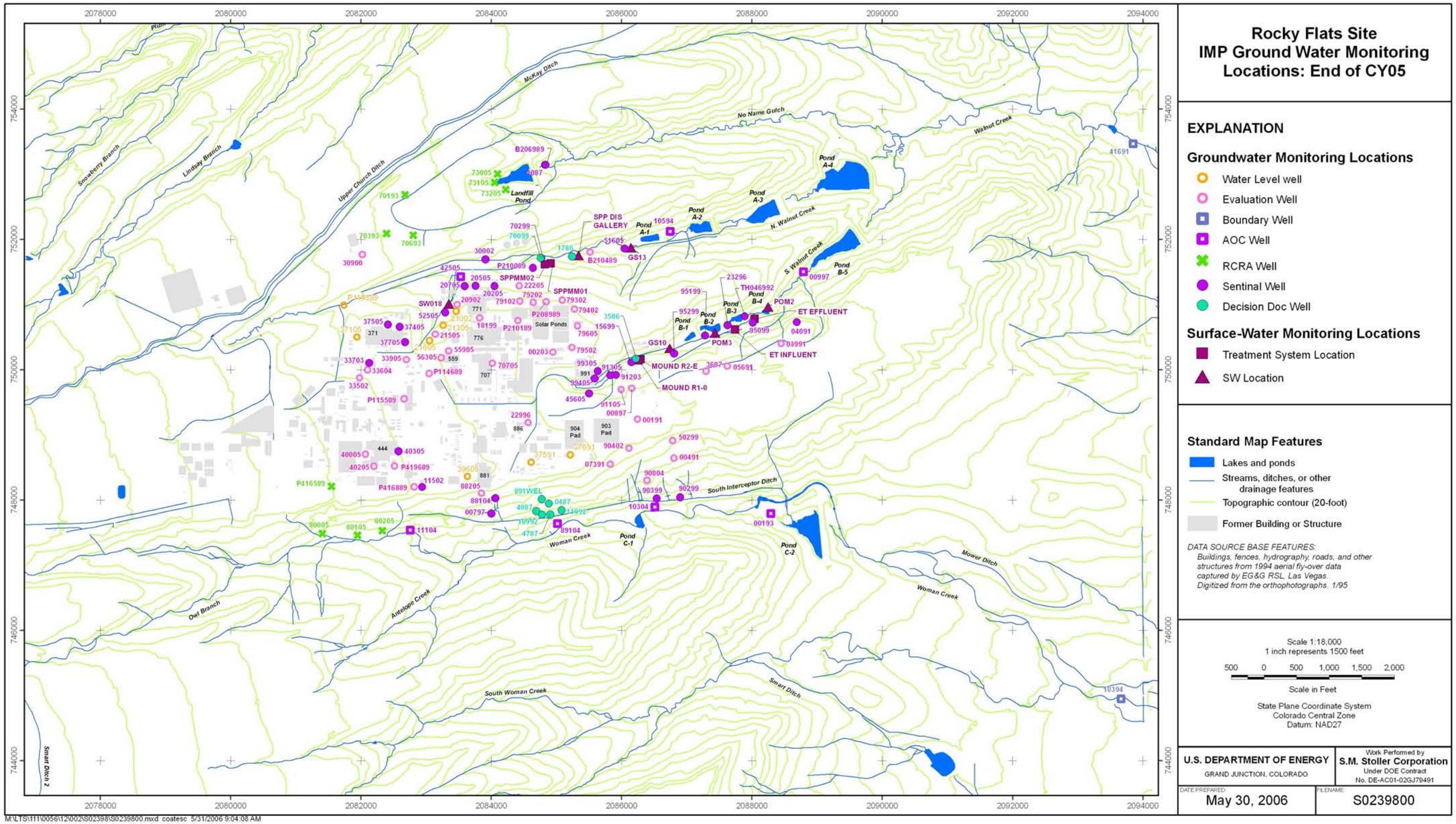

Figure 3–1. Ground Water Monitoring Network

Included within these well classifications are wells that satisfy the performance monitoring requirements of accelerated actions at the Site that have addressed contaminant source areas and ground water plumes.

Section 3.3.9 of the 2006 IMP Background Document provides a more thorough discussion of the well classifications and associated well classification-specific DQOs. Refer to Section 3.3.3.2 for 85th percentile calculations, Section 3.3.3.3 for trend testing, and Section 3.3.3.4 for information on the Wildlife Refuge Worker Surface Water Preliminary Remediation (WRW SWPRG) (Kaiser-Hill 2004b) comparison. Section 3.3.3.5 describes comparisons specific to uranium in ground water.

For most of the wells in the monitoring network, some or all of these evaluation criteria will apply. At the two landfills (Present Landfill and Original Landfill), comparisons include downgradient vs. upgradient water quality and trend testing, as well as (at the Original Landfill only) quantification of the 85th percentile.

Concentrations of contaminants in ground water samples from AOC wells will be compared against all four evaluation criteria (85th percentile, trending, WRW SWPRGs, and the uranium threshold). If evaluation thresholds are exceeded, a ground water evaluation will be performed to determine the cause and to determine any appropriate action. Ground water concentration data from Evaluation wells that are located within contaminant plumes will only be assessed for whether monitoring of a plume may cease. Samples from these wells are anticipated to continue to show elevated concentrations and not require any action. Instead, decreasing concentrations will lead to a termination of monitoring when concentrations are below a specific threshold. Ground water concentration data from Sentinel wells that are located near downgradient plume edges, between AOC and Evaluation wells, may be evaluated as part of the CERCLA periodic review, using all but the WRW SWPRG criteria listed above. See Section 3.3 of the 2006 IMP Background Document for more detailed discussion of DQOs and decisions.

Water-level measurements will be collected at all wells, not only at Water Level wells. The resulting data are incorporated into potentiometric surface maps and hydrographs to define ground water gradients and flow rates. Both the water-level measurements and the sampling and analysis activities provide temporal data for use in assessing trends.

3.2 Ground Water Monitoring Program

The Ground Water Monitoring Program includes the following components (see 2006 IMP Background Document, Appendix B, for tables of monitoring locations and analytical suites):

- Sampling of monitoring wells;
- Measurement of water-table elevations;
- Data management, interpretation, and reporting;
- Performing ground water evaluations; and
- Well installation, maintenance, abandonment, and replacement.

Table 3−1 lists the frequency and number of monitoring wells for samples and water levels.

Table 3–1. Ground Water Monitoring Matrix

Type of Monitoring	Locations	Well Classification	Sampling Frequency	Purpose
Measure analyte concentrations	39 wells and two surface water locations	AOC and Sentinel	Semiannually	Monitor analyte concentrations in ground water at downgradient plume edges and in drainages
Measure analyte concentrations	10 wells	RCRA	Quarterly	Monitor analyte concentrations in ground water at Present Landfill and Original Landfill
Measure analyte concentrations	40 wells	Evaluation	Biennially	Monitor analyte concentrations in ground water within plumes and within Industrial Area
Measure analyte concentrations	2 wells	Decision Document	Quarterly	Monitor per OU1 CAD/ROD
Measure analyte concentrations	7 wells	Decision Document	Semiannually	Monitor per OU1 CAD/ROD or decision document that applies to ground water treatment system
Measure analyte concentrations	2 wells	Boundary	Annually	Monitor analyte concentrations in ground water at east Site boundary
Water-level measurement	126 wells	All wells (AOC, Sentinel, Evaluation, RCRA, Decision Document, Boundary, and Water Level)	At least semiannually	Monitor ground water flow regime
Measure analyte concentrations	7 treatment system monitoring points and 3 associated surface-water locations	Treatment System	Semiannually	Monitor analyte concentrations in influent to and effluent from treatment systems, and in surface water downstream of effluent discharge location

Notes:
AOC = Area of Concern
CAD/ROD = Corrective Action Decision/Record of Decision
OU1 = Operable Unit 1
RCRA = Resource Conservation and Recovery Act

3.2.1 Well Locations

Most of the ground water at RFS is hydraulically connected to surface water. Ground water monitoring wells have been installed along known or suspected pathways between contaminated areas and surface water. As shown in Figure 3−1, the majority of the monitored wells are located within and around the perimeter of the former Industrial Area and the Present Landfill. Additional wells are located within RFS drainages where stream flow is present at least some portion of the year. Boundary wells are maintained at the downgradient (eastern) RFS boundary. The monitoring well classifications are populated as follows:

- AOC: 7 wells plus 2 Surface Water Support locations;
- Sentinel: 32 wells;

- Evaluation: 40 wells;
- Boundary: 2 wells;
- RCRA: 10 wells;
- Decision Document: 9 wells; and
- Water Level: 26 wells.

In addition, monitoring of the three ground water intercept/treatment system monitoring points is performed as a part of the ground water portion of the IMP. Ten locations are monitored for this purpose.

3.2.2 Ground Water Sampling and Analysis

During sample collection activities at each monitoring well, the sampling crew measures field parameters including ground water temperature, pH, conductivity, turbidity, and total alkalinity. At most of the wells identified for analytical sampling, the crews will collect one or more of the following three samples:

- Unfiltered samples for analysis of VOCs;
- Unfiltered samples for analysis of nitrate; and
- Filtered or unfiltered samples for analysis of total uranium.

AoIs vary between wells depending on the constituents present in each plume at or upgradient of the well; and whether agreements (typically specified in decision documents) require the collection of additional analytes. In past years, the activities of several uranium isotopes were measured. In 2006, the total concentration of uranium (irrespective of isotopes) will be measured. See Section 3.3.3.5 and Appendix B in the 2006 IMP Background Document for more information.

The ground water flow regime at RFS limits sample volumes from many wells. If sample volume precludes collection and analysis of the entire analyte suite for a particular well, the analytes are prioritized based on the objectives of the well. The following list shows the usual analyte priority at most wells; however, this priority may be modified to meet the sampling objectives for a particular well:

- VOCs;
- Nitrate; and
- Total uranium.

Wells monitoring the Present Landfill will be sampled for VOCs and metals, and those monitoring the Original Landfill will be sampled for VOCs, semivolatile organic compounds, and metals. These suites have been determined via consultation with the CDPHE and EPA. Samples from five wells, one located north and one east of Building 371, and three north of Building 771, will also be analyzed for plutonium and americium. These analytes were added to respond to community concerns. Samples from one well located north of the MSPTS will be monitored for VOCs, uranium, plutonium, americium, gross alpha, and gross beta, in accordance with the decision document for that ground water treatment system.

3.3 Ground Water Data Disposition

3.3.1 Databases

Field personnel enter field data into the FieldPar data entry module, which is compatible with the SEEPro database. Database personnel load analytical data into the SEEPro database. Data integrity is maintained through the use of standard data entry operating procedures and by running error-checking routines when loading data.

Data are extracted for various uses, including quarterly reporting, annual reporting, and ad hoc queries to support other data needs that may arise. These data are also mapped using a geographic information system to delineate the distribution and movement of ground water and constituents in ground water.

3.3.2 Reporting

Ground water monitoring activities are reported through the following vehicles:

- Interpretive discussion of ground water data and conditions will be provided in Quarterly Reports of Site Surveillance and Maintenance Activities which contain a summary of ground water monitoring data collected in the respective period at RFS; and
- Annual Reports of Site Surveillance and Maintenance Activities which will contain a complete evaluation of ground water monitoring data collected during the calendar year.

In 2006, reports have been presented at quarterly information exchange meetings that are open to the public.

- **IMP:** The IMP has been reviewed and updated as needed through physical completion. The IMP is the vehicle for documenting required Ground Water Monitoring Program elements during that time. Upon final regulatory closure, the IMP will be replaced by a component of the Long-Term Surveillance and Maintenance Plan.

3.4 Ground Water Evaluations

Some of the DQOs for ground water monitoring require an evaluation of the potential impact of ground water contamination on surface-water quality (see Section 3.3.5 of the 2006 IMP Background Document). If AoI concentrations at AOC wells do not meet the associated requirements (see Section 3.3.9.1 of the 2006 IMP Background Document), an evaluation will be performed. DQOs will be developed and presented as part of the ground water evaluation.

3.5 Well Abandonment and Replacement Program

Section 3.5.7 of the 2006 IMP Background Document describes the Well Abandonment and Replacement Program (WARP), which is responsible for removing damaged and unnecessary wells and installing replacement wells as needed. RFS personnel maintain a database of well locations, construction, permitting, and other relevant information. The Site geologic core repository is no longer maintained and has been disposed. A file of geologic core logs is maintained.

Well abandonment is considered if a well is damaged or no longer needed, or is poorly constructed for long-term monitoring. Well replacement is considered if a well is part of the long-term monitoring network and is damaged or is not constructed appropriately for long-term monitoring. Activities planned for the WARP were completed in 2005.

3.6 Project-Specific Monitoring

Ground water monitoring to support project-specific remediation and decommissioning activities ended in FY 2005. In the unlikely event that it is necessary to perform monitoring for some projects as yet unidentified, such monitoring will be performed on an as-needed basis. This monitoring is intended to detect potential impacts on ground water quality from a specific project. If necessary, monitoring to support this objective can employ any of the existing wells that may be appropriately located.

End of current text

4.0 Air Quality Monitoring

4.1 Purpose and Programs

Air monitoring activities at RFS assist in both protecting and informing the public, and in protecting the environment, by detecting and trending the impacts of RFS operations on air quality at and near RFS. Monitoring characterizes airborne radionuclide materials that may be introduced and identifies the associated meteorological conditions that influence the transport and dispersion of them. Data can be used to plan, implement, and assess the effects of on-Site activities and to maintain emergency preparedness and demonstrate compliance with relevant regulations.

The Air Quality Management group within Kaiser-Hill's Environmental Systems and Stewardship organization originally determined the scope of RFS air monitoring and reporting activities required to maintain compliance with air quality regulations and DOE Orders. The reduced monitoring approved for implementation following physical completion was initiated in October 2005 and consists of only ambient radionuclide particulate monitoring and collection of meteorological data from the National Renewable Energy Laboratory (NREL). Effluent monitoring and project-specific monitoring have been terminated. Monitoring is currently performed by S.M. Stoller subcontracted personnel.

4.1.1 Ambient Air Monitoring

Ambient monitoring of radionuclides on RFS and at the perimeter is performed by S.M. Stoller. Monitoring is performed at three monitoring locations, two predominantly downwind during major wind events and one predominantly upwind during such events but close to a major off-site source of airborne particulate emissions. Table 4−1 outlines the basis of the ambient monitoring activities, and also reflects the present scope of meteorological monitoring. All other monitoring has been terminated and is not outlined in this table.

Table 4–1. Air Monitoring Matrix

Type of Monitoring	Analyte	Locations	Performed By	Sampling Frequency	Purpose
Routine ambient air	Radio-particulate	25 RAAMP samplers through August 2005; 14 thereafter until October 2005 physical completion; 3 subsequent to that time[a]	S.M. Stoller	Continuous (monthly filter exchange; monthly analyses of 3 perimeter samplers)[a]	Detect and characterize Site-related airborne radiological emissions and demonstrate continued low emissions.
Meteorology	NA	NREL M2 tower 1.2 miles north of former RFS tower	NREL	Continuous	Monitor meteorological conditions for use in assessing possible upset conditions at RFS.

Notes:
NA = Not applicable
NREL = National Renewable Energy Laboratory
RAAMP = Radioactive Ambient Air Monitoring Program
RFS = Rocky Flats Site

4.1.2 Effluent Air Monitoring

All Site buildings that were historically subject to effluent monitoring have been removed, and the effluent monitoring program has been terminated.

4.1.3 Meteorological Monitoring

On-Site meteorological monitoring historically supported both the reporting requirements of 40 CFR 61, Subpart H, "National Emission Standards for Emissions of Radionuclides Other Than Radon from Department of Energy Facilities" (Rad-NESHAP) and the emergency response requirements of DOE Orders. Meteorological data are no longer measured on Site; instead, representative meteorological data are collected by NREL at the M2 tower, located approximately 1 mile due north of the former RFS meteorological tower. M2 tower data are queried by support staff at regular intervals. Data are no longer needed to demonstrate compliance but may still be used to assess air impacts from unusual or potential upset conditions at the site. They are also used in the water programs.

4.1.4 Project Monitoring

Project monitoring continued through August 2005, at which point the program was terminated.

4.2 Site Air Monitoring Scope

Currently only ambient air monitoring is performed at RFS. Meteorological data are collected from a representative offsite location. All other monitoring has been terminated.

4.2.1 Ambient Air

The Radioactive Ambient Air Monitoring Program (RAAMP) collects ambient radioparticulate air data. Since October 2005, the RAAMP network consists of three size-partitioning, high-volume ambient air samplers. With the removal of all facilities at the site, there is no longer a monitoring requirement to demonstrate compliance with Rad-NESHAPS, monitoring is performed now to verify the low emissions expected following completion of the building removals and land reconfiguration activities.

The three perimeter RAAMP samplers run continuously, collecting airborne particles on pairs of sample substrates that segregate smaller inhalable particles from larger, more easily deposited airborne particulate matter. Filters and impactor substrates are routinely collected and submitted for analysis for specific isotopes of plutonium, uranium, and americium. The FY 2006 IMP Background Document, Rev. 1, details specific sampling intervals and analytical detection limits.

No other ambient monitoring is performed.

4.2.2 Meteorological Conditions

Continuous meteorological monitoring is conducted by NREL at its M2 tower 1.2 miles north of the former Site meteorological tower location. Collected data comprise wind speed, wind

direction, temperature, relative humidity (dew point), precipitation, and a calculated sigma-theta (used to determine Pasquill-Gifford stability classes). Data are used to assess potential air impacts from upset conditions or unusual events at the site.

4.3 Future Radiological Air Monitoring

Following completion of accelerated actions, the only potential sources of radionuclides are the low concentrations of residual contamination that remain in the surface soil as allowed under the closure agreement. Under these Site conditions, ambient air monitoring has been continued by DOE voluntarily for some period of time to confirm low emissions. Ambient monitoring is being performed at three existing locations.

Plutonium-239/240, americium-241, and uranium-233/234, -235, and -238 are monitored monthly at the three RAAMP samplers and a rolling 12-month average dose is calculated. If ambient levels of Site-derived radionuclides are demonstrated to be significantly below 0.1 millirem per year for 3 consecutive years, radionuclide ambient air monitoring may be discontinued. This time frame was selected since continued recovery of vegetation on Site will further reduce dust emissions over time. Consequently, absent additional disturbances, highest emissions should occur immediately following completion of accelerated actions and before full vegetative recovery. The results of the ambient radionuclide air monitoring will be reported annually to CDPHE and EPA.

End of current text

5.0 Ecological Monitoring

The Buffer Zone around the Industrial Area at RFS is one of only a few areas along Colorado's Front Range that has remained largely undisturbed by encroaching development. The Buffer Zone contains several unique assemblages of animals and vegetation. Five major vegetation communities have been identified at RFS:

- Xeric Tallgrass Prairie;
- Tall Upland Shrubland;
- Great Plains Riparian Woodland Complex;
- High Quality Wetlands; and
- Mesic Mixed Grassland.

Ecological monitoring is designed to provide information necessary for regulatory compliance and to manage and conserve the plant communities and wildlife in the Buffer Zone, including special-concern species (i.e., threatened, endangered, candidate, proposed, state-listed, or other sensitive species). The Preble's meadow jumping mouse (Preble's mouse) is of particular concern because it was listed as a threatened species on May 13, 1998. Ecological monitoring is also designed to provide information necessary to manage revegetated areas in the Buffer Zone and the former Industrial Area.

Following physical completion, large portions of RFS that are currently managed by DOE will be transitioned to U.S. Fish and Wildlife Service (USFWS) management. DOE-LM and USFWS are working on a possible Memorandum of Understanding (MOU) that would formalize aspects of the post-physical completion monitoring that will be performed. Monitoring covered by the evolving MOU will not be governed by the IMP.

5.1 Monitoring Objectives

The Ecological Monitoring Program (summarized in Table 5−1) is designed to provide data that can be used in management and conservation decision making. Monitoring has been categorized into regulatory compliance monitoring and BMP monitoring. Regulatory compliance monitoring is that required by permits, biological opinions, decision documents, or other statutes or rules. BMP monitoring is defined as monitoring not required by a regulatory driver, but important for making management decisions. It may involve monitoring different variables in the plant communities or wildlife populations such that changes in these variables would trigger ecological protection and compliance decision making. Comparisons of monitoring data over time enable ecologists to detect changes, identify potential causes, and plan corrective actions for changes that result from RFS activities, rather than from natural fluctuations.

Table 5–1. Ecological Monitoring Matrix

Basis for Monitoring	Number of Locations	Sampling Frequency	Purpose of Monitoring
Provide general information on significant wildlife species at RFS.	Variable by year	Variable by survey type	Track changes in numbers, richness, and area use of significant wildlife species at RFS.
Monitor noxious weeds at RFS; comply with weed control regulations	Variable by year	In flowering season and as available for observation	Evaluate effectiveness of weed control actions, and aid in out-year planning for weed controls at RFS.
Perform monitoring of selected revegetation areas	Variable by year	Annually	Evaluate effectiveness of revegetation efforts. Use information for management of areas.
Regulatory compliance mitigation monitoring	Variable by year (as specified in permits, biological opinions, decision documents)	Annually	Provide regulatory agencies with information on performance of mitigation success.
Monitor for the presence, or potential presence, of special-concern, threatened, or endangered plant and wildlife species and wetlands; comply with federal, state, and local protection and conservation regulations	Variable by year	As required	Ensure compliance of projects with applicable ecological regulations and protect rare, threatened, and endangered species from harm.

5.2 Scope of Monitoring

Several types of monitoring have been conducted in the five vegetation communities, as well as monitoring of some activities specific to one or more communities. The following activities are common to the five vegetation communities:

- Define the extant area of the community.
- Provide baseline estimates of the presence of birds and mammals, and estimate the baseline species richness of plant, bird, and mammal populations (plant species richness baseline will be determined from 1993–1996 or 1997 data, as applicable; the bird and mammal baseline was established in the *1996 Annual Wildlife Survey Report* (Kaiser-Hill 1997).
- Identify rare or imperiled plant or animal species.
- Conduct weed mapping and photo surveys.
- Monitor the presence of noxious weeds and the effects of weed control efforts.
- Anticipate impacts from RFS projects, and estimate the potential area affected.
- Perform monitoring of selected revegetated areas after remediation activities.

Weed monitoring is conducted in areas beyond the five vegetation communities listed above.

5.2.1 Wetlands

In addition to the activities listed above, the U.S. Army Corps of Engineers and EPA conduct periodic wetland characterizations. EPA is the lead agency on wetlands for CERCLA project

activities impacting wetlands. The U.S. Army Corps of Engineers is the lead agency on wetlands for non-CERCLA project activities. The last site-wide characterization was completed in 1994.

5.2.2 Project-Specific Monitoring

RFS projects are also evaluated in terms of potential effects on threatened and endangered (T&E) species, species of special concern (SSC), migratory birds, and wetlands. Additionally, monitoring is conducted for the revegetation projects in accordance with the *Rocky Flats, Colorado, Site Revegetation Plan* (DOE 2005c). Much of the data for such evaluations comes from the monitoring activities listed above and previously collected baseline information, but additional data needs have been identified to assess the impact of such projects in specific areas. Project-specific data needs include:

- Seasonal presence or absence of affected species, and the seasonal timing of the project;
- Presence of habitat considered suitable for T&E and SSC species;
- Biological characteristics of species of concern (e.g., feeding and nesting habits, home range, habitat preference), and effects of the project; and
- Revegetation location monitoring data.

Projects are also evaluated in terms of their impacts to migratory birds and RFS wetlands. Wetlands include both those areas mapped by the U.S. Army Corps of Engineers and those areas not included on the map.

Certain project activities require a biological assessment or biological opinion, or a wetland mitigation plan. These plans may include monitoring activities for specified objectives over time. The DQOs for each activity are indicated in the project-specific biological assessment or opinion, or mitigation plan.

5.3 Outside Factors Affecting RFS Ecology

The ecological resources at RFS are influenced not only by Site activities but also by issues and activities that occur off Site. Outside factors that may affect ecological resources at RFS include, for example, noxious weeds, chronic wasting disease, West Nile virus, plague, and other zoonoses. These and other factors often affect the surrounding region, which must be considered when evaluating the ecology of the Site.

For example, the Colorado Division of Wildlife killed and tested a portion of the existing deer population for chronic wasting disease in late FY 2002. If chronic wasting disease had been found, it may have been necessary to destroy the entire population.

Activities on adjacent properties may also impact Site vegetative communities and habitats. The Site borders lands used for various activities, including grazing, mining, and open space. While the Site continues to implement a comprehensive integrated vegetation management program, the Site is influenced by the activities on neighboring lands that are beyond the control of Site personnel. Wind-blown materials (i.e., noxious weeds) from lands can readily cross property lines, as can prairie dogs. Climate changes have the potential to affect the plant communities as do weed control efforts or the lack thereof, on lands surrounding RFS. Sociological and political factors have the potential to affect the ecology at RFS. For example, social or political pressures

that restrict the use of grazing or prescribed fire on the grasslands will affect the long-term sustainability of the prairies at RFS.

5.4 Data Management

Ecological data were historically stored in two databases, the Ecological Monitoring Program Database and the Sitewide Ecological Database. Because extracting data for specific purposes requires a high degree of system-specific knowledge, the two databases were combined. The new database, the Site Ecological Database, allows for multi-user access (with security restrictions) for Site personnel. This database contains data from the early 1990s through the end of 2001. Since 2002, data are available in separate databases for each monitoring study.

5.5 Reporting

The Ecological Monitoring Program has produced an annual ecology report for the Site since the mid-1990s. The final annual ecology report produced by Kaiser-Hill was prepared in 2005 to summarize and report the data collected in 2004. The Ecological Monitoring Program also provides the reports required for regulatory compliance as directed by permits, biological opinions, and RFCA decision documents. Future reporting efforts will be determined by DOE-LM.

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